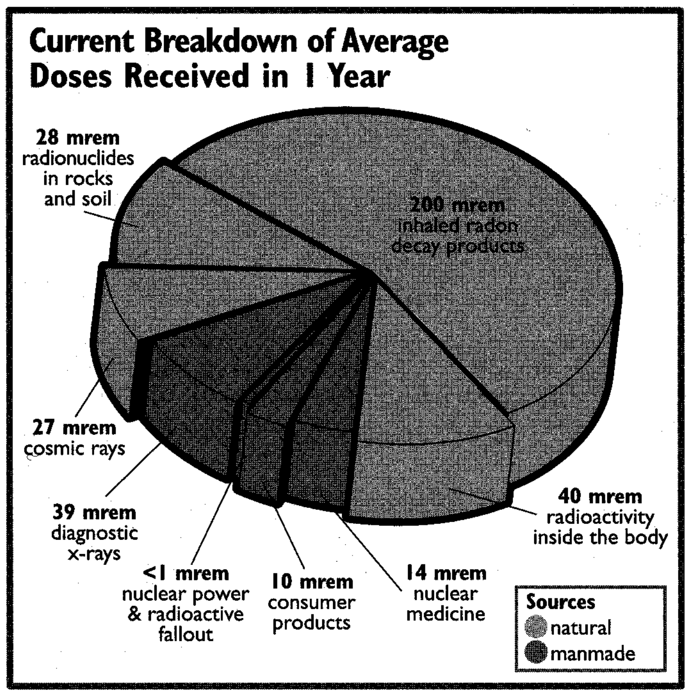
Savannah River Site fact sheet

Radiation in Our Environment

Radiation is a natural part of our environment. There are also manmade sources of radiation exposure that contribute to the dose we all receive each year.

Natural sources include cosmic radiation, external radiation from the earth's crust, and internal radiation from radionuclides inhaled or eaten and retained in the body. The place we live has a large influence on these natural exposures to cosmic radiation. Because the atmosphere absorbs cosmic rays, living at a higher altitude means that less radiation has been absorbed by the air before reaching us, resulting in increased exposure. The local geology determines the amount of radiation exposure received from naturally radioactive elements such as uranium, thorium, and potassium-40 in the earth. Uranium levels in the soil and rock also determine the amount of radon gas released. The local geology and the type of house in which we live determine the amount of radon gas we breathe. Some naturally occurring radionuclides, such as potassium-40, lead-210, and carbon-14, are also found in our food and water, resulting in internal radiation exposures.

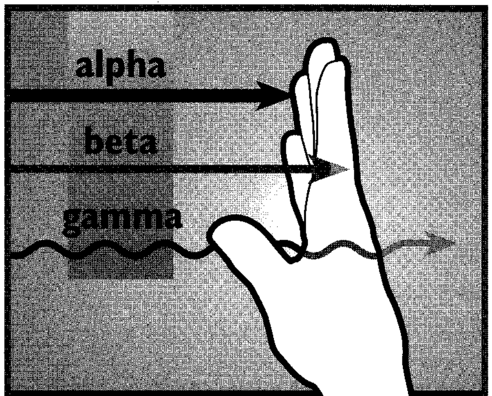
Manmade sources of radiation exposure include x-ray examinations, nuclear medicine, nuclear power plants, weapons production facilities, research facilities, consumer products, and the past atmospheric testing of nuclear weapons. Phase II of the Savannah River Site (SRS) Environmental Dose Reconstruction Project, being conducted by the *Radiological Assessment Corporation* under contract with the Centers for Disease Control and Prevention, will determine past releases of manmade radioactive material from the operations at the SRS.



The above figure presents the current breakdown of average doses received in a year from the common sources of radiation. Not everyone receives the same dose. Medical and consumer product doses vary widely. A person who is healthy will not be exposed to diagnostic radiation or nuclear medicine procedures, for example radioactive tracers.

All matter is composed of atoms, which are made of neutrons, protons, and electrons. The atom's nucleus is formed from neutrons and protons, and electrons surround the nucleus. Radionuclides are composed of unstable atoms that release energetic particles or waves as they change (decay) into more stable forms. The particles and waves are ionizing radiation. The decay of the atoms is called radioactivity and is reported in units of curies (Ci), or becquerels (Bq).

The most common types of radiation are alpha particles, beta particles, and gamma rays. Each type has different physical characteristics and, therefore, interacts differently with matter. For human exposures, these differences are taken into account when estimating the doses received. One important difference is the penetrating power of the different



The Penetrating Power of Radiation

types of radiation. As illustrated, alpha particles are stopped by the dead layer of skin. The degree of penetration of the beta particle depends on its energy. Typical gamma rays will give up only part of their energy as they pass through a human hand.

As time passes, the number of atoms of the radionuclide is reduced by decay. In successive half-lives, the radioactivity decreases to one-half, one-fourth, one-eighth, etc. of the initial value. Each radionuclide has a unique and unalterable half-life; therefore, it is possible to predict the amount of activity remaining at a future time.

Depending on what is being estimated, different quantities of dose are used. The definitions are given in the glossary. The absorbed dose is reported in units of rad or gray (Gy), and the equivalent dose and effective dose are reported in rem or sievert (Sv). The units of the collective dose are person-rem or person-Sv. Environmental doses are often quite small, and may be divided into smaller units called millirem (mrem), one-thousandth of a rem.

Public Participation

Public involvement is a key part of the dose reconstruction project. During the course of the project, workshops and meetings will be held to explain progress and ask for ideas from people who are interested in the work. For more information or to provide input, call the toll-free number, 800-637-4766.

Typical Radiation Exposures

1 mrem = average annual dose to person from living near a nuclear power plant
2.5 mrem = cosmic radiation dose received while flying from New York to Los Angeles
10 mrem = average dose from one chest x-ray
31 mrem = average annual dose from cosmic radiation in Atlanta
50 mrem = average annual dose from cosmic radiation in Denver
63 mrem = average annual dose from the rocks and soil in Denver
160 mrem = average annual dose to flight attendants from cosmic radiation
300 mrem = annual dose received by a radiology technician
525 mrem = annual dose to a hypothetical person living continuously in Grand Central Station in New York City (from building materials)
100 mrem-1 rem = range of doses received by astronauts on a space mission
7 rem = annual dose from living continuously in areas of high radioactivity in Brazil

Glossary

Alpha particle is composed of two protons and two neutrons.
Beta particle is a high-energy electron ejected from the nucleus of an atom.
Gamma ray is a discrete amount of electromagnetic energy that is emitted, often accompanying alpha or beta particle emissions, when an unstable radionuclide decays.
Half-life is the time interval during which one-half of the initial number of atoms of a radionuclide undergo radioactive decay.
Absorbed dose is the amount of energy deposited by radiation in a unit mass of material. For human exposure we consider the absorbed dose to tissue.
Equivalent dose is the average absorbed dose to a tissue multiplied by a radiation weighting factor. This takes into account the ability of the radiation being considered to cause effects in the tissue.
Effective dose takes into account the different sensitivities of various body tissues. To accomplish this, the equivalent dose is multiplied by a tissue-specific weighting factor. The tissue weighting factors reflect, approximately, the sensitivity of various body tissues to radiation.
Collective dose is the sum of the effective doses to all the people exposed to a source of radiation.